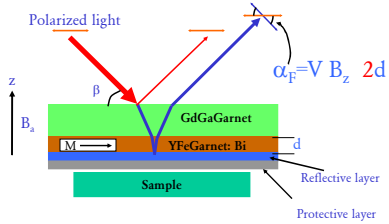
Demonstration of Single Boundary Measurement Techniques Applied to Partially Cold Worked Large Grain Niobium Sheet

Lee P. [1], Polyanskii A.[1], Gurevich A. [1], Squitieri A.[1], Larbalestier D. [2], Bauer P. [2], Bellantoni L.[2], Boffo C. [2], Edwards H. [2], P. Kneisel.,[3]
[1] Applied Superconductivity Center at the University of Wisconsin-Madison, USA, [2] Fermilab, Batavia, IL, USA, [3] Jefferson Lab, Newport News, Virginia, USA

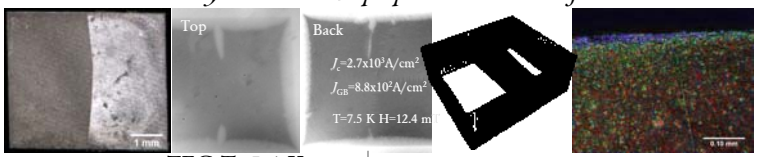
MO imaging shows classic rooftop pattern for triple point sample #4 even with 13 μm step at GB

Top Surface Light Image | T=5.5 K, H=120 mT | 3D Model | ZFC T=5.7 K H=60 mT | Depth Map, 15 μm Range

Magneto-Optical double Faraday effect in reflective mode in YIG indicated film with in-plane magnetization

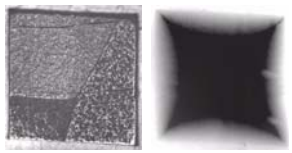


MO imaging shows flux penetration at grain boundary in bi-crystal with GB perpendicular to surface

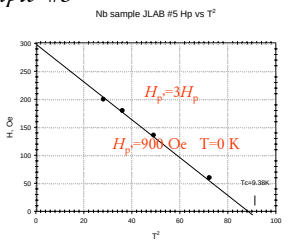


Top Surface Light Image | ZFC T=5.6 K H=8.4 mT | 3D Model | Depth Map, 5 μm Range

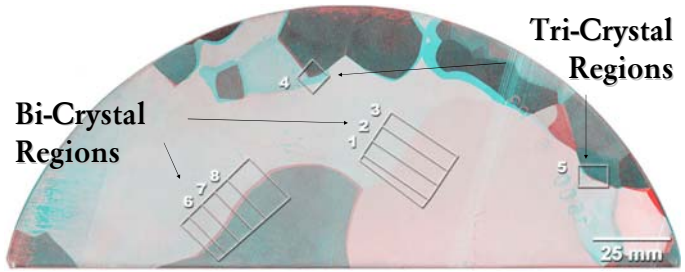
MO imaging shows classic rooftop pattern for triple point sample #5

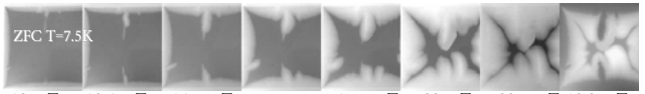


Top Surface Light Image | ZFC T=5.3 K H=120 mT

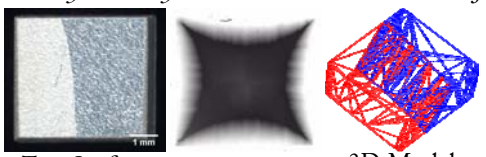


External Field H_p Of First Flux Penetration





MO imaging did not show flux penetration at grain boundary in bi-crystal with GB at ~30° to surface



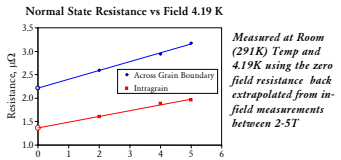
Top Surface Light Image | ZFC T=5.5 K H=120 mT | 3D Model

Experiment

Measurements on Partially Cold-Worked As-Received: Large Grain Nb Ingot Slice Courtesy of Peter Kneisel at Jefferson Lab: *JLab have fabricated two superconducting cavities from the center of a large grain Nb billet. Both cavities had excellent properties with one reaching 185 mT and the other attaining a gradient of 45 MV/m.*

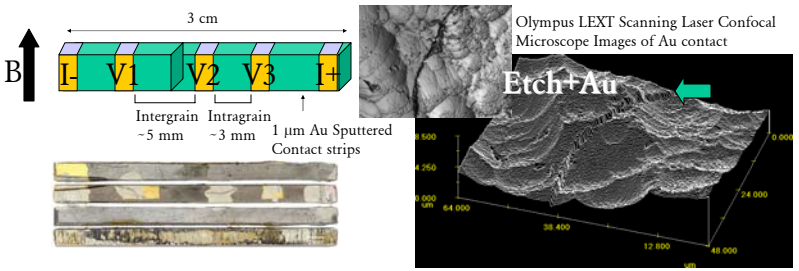
Au Contacts Successfully Applied Across Bi-Crystal with flux penetration

Residual Resistance Ratios

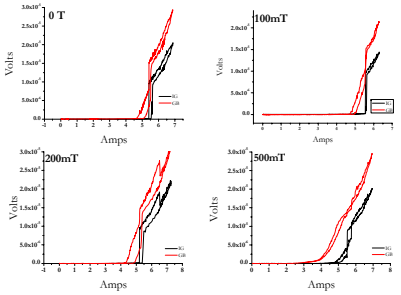


Measured at Room (291K) Temp and 4.19K using the zero field resistance back extrapolated from in-field measurements between 2-5T

- **Across grain boundary – 187**
- **Within grain - 211**



Critical Currents at 4 Fields 4.2 K



Summary

1. MO Imaging shows flux penetration at perpendicular grain boundary in as-received slice with residual cold work on surface.
2. Flux penetration behavior is not topologically related.
3. Initial resistivity measurements indicate grain boundary weakness.